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The Perspective of Small Fisherman Toward the Seagrass Conservation Values for the Sustainability of Friendly Environmental Fish Farming: a Case Study in Coastal Waters of East Lombok

By

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Abstract

Seagrass is marine plant species that have essential ecological functions for the sustainability of fish resources and biodiversity. However, its worth is not considered as other ecosystems (mangroves and coral reefs). This study aims to assess the small fisherman's perspective on seagrass conservation for the sustainability of eco-friendly cultivation at the study sites. The data were collected using survey methods, questionnaires, in-depth discussions and discussions. The all data were analyzed using descriptive statistical analysis method. The results showed that small fishermen in the study sites can classify seagrasses based on their morphological characteristics and seagrass functions serving as: supporting services, regulation and maintenance. The results show that most of respondent's assessment evaluate it as in level of quite useful and useful. In addition, fishermen can identify the source of the threat of seagrass sustainability at the study area and that regularly is the use of distructive and over-fishing. The ecological knowledge of small fishermen from the aspects of seagrass conservation is important, especially for the sustainability of friendly environmental cultivation. Therefore, it should be considered in the policy at local, regional and national level of seagrass conservation based on empowerment of small fishermen through friendly environmental cultivation.

Keywords: small fisherman, seagrass conservation and firendly environmental cultivation

I. Introduction

Seagrasses are flowering plants that have grow to the marine environment and have a vital of function in ecological systems at the marine environment, especially for the sustainability of fish and marine biota. In this regard, seagrasses serve to support the sustainability of fishery economic resources and other fish from different habitats (Ruseler *et al*., 2008: Fortes et al., 2011: Cullen-Unsworth et al., 2013). Nevertheless, the threat of seagrass sustainability, particularly the

waters of Indonesia could have a negative impact on the sustainability of fish resources and the protection of marine biodiversity (Syukur et al., 2017).

Indonesian government has been aware the virtue of the protection of seagrass ecosystems and seagrass conservation can be instrumental in monitoring the health of coral reefs (Syukur and Santoso, 2017). However, the function of seagrass ecology is neglected in protection compared to other ecosystems (coral reefs and mangrove) by the government and people of Indonesia (Nadiarti et al., 2012). This is seen from the effort conservation of seagrass at the national and regional levels in coastal waters of Indonesia is still very limited (Syukur et al., 2016), Therefore, the efforts of seagrass conservation in coastal waters of Indonesia is through collaboration with traditional fishermen. In this case, the concept of environment-friendly farming may be considerebly as a strategy for the conservation of seagrass beds and as a solution for economic development traditional fishermens (Syukur et al., 2016).

The aquasilviculture technology could serve as a model for initiating further conservation strategies on Philippine mangrove forest in other critical wetlands (Flores, 2016). In this case, many seagrass areas on a local scale that require conservation. Therefore, local communities in this case fishermen can be involved in supporting eco-friendly cultivation as a complementary livelihood, such as at the location of study. Fishermen have the advantage of their ecological knowledge of the environment and marine organisms (animal, plants and their forms of threat), and ecological knowledge of local communities can be an instrument for managing coastal ecosystems such as seagrass ecosystems (Syukur, 2013). That is why the focus of this paper is the perspective of small fishermen on the value of seagrass conservation to support the sustainability of eco-friendly cultivation in the study area.

II. Materials and Methods

This study was conducted on April to November 2015 and April to November 2016 in the coastal areas of East Lombok. The geographical position of research area is 116°37'-116°45' east longitude and 8°17'- 8°18' latitude south (Figure 1). The study populations are small fishermen in the study location with a sample size of 100 fishermen. The sampling was done

purposively, with our criteria for the selection of research participants were that they: 1) had a minimum of 30 years'experience as fishermen; 2) fished of their time around the seagrass beds; 3) had a knowledge of seagrass and biota and 4) were aware of the conservation (Syukur et al., 2017). Data were obtained through the use survei, questionnaires, interviews and focus group discussions. Questionnaire in the form of semi-structured and open questions to obtain qualitative and quantitative information. Information collected includes: i) knowledge of seafarers; ii) knowledge of fishermen on the source of threats and ecological functions of seagrass; iii) their perspectives on seagrass conservation and iv) the value of seagrass conservation for the sustainability of eco-friendly cultivation. Data analyses were using descriptive statistical analysis method, to describe the perspective in an objective, systematic and conceptual manner.

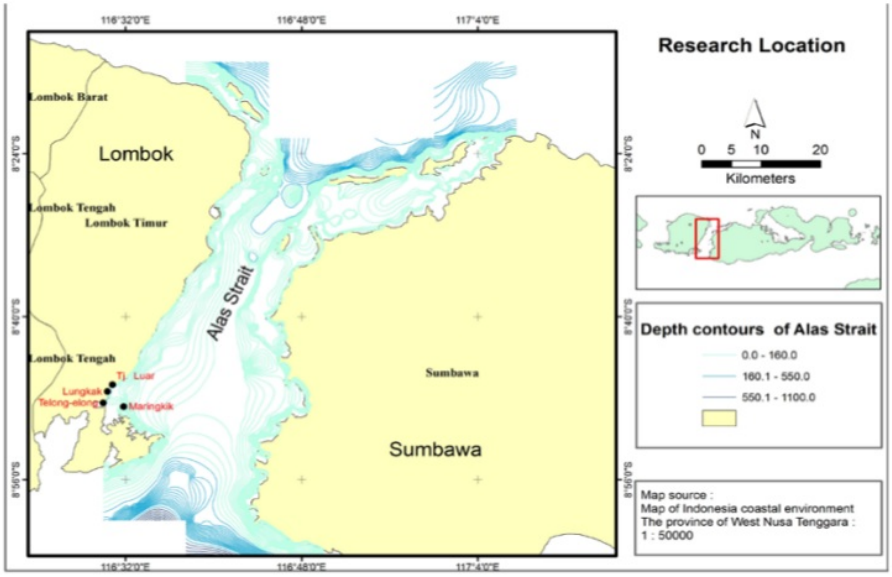

Figure 1. Research Location (Syukur et al., 2016)

III. Results and Discussion

3.1. Fishermen's Knowledge on Seagrass in Study Area

Fishermen at the study area not only recognized seagrasses as fertile vegetation in the marine environment, but they understood the seagrass more broadly. The small fishermen are coastal communities with knowledge of the marine environment and their indicators understand marine phenomena and their organism diversity, such as the existence of seagrasses (Syukur et al, 2013). The community's knowledge to identify the value of natural resources such as seagrasses is a form of goods and services obtained from the seagrass location (Ronnback and de la Torre-Castro 2004). The results of interviews and in-depth discussion that the fishermen at the study area have grouped seagrass into four groups, namely: 1) the fruit-producing is *Enhalus acoroides*; 2) seagrasses that spread, Halophila; 3) green seagrasses is Cymodocea and 4) seagrass grass, *Halodulle pinifolia* and *Syringodium isotifolium*. Furthermore, it is mentioned that they can distinguish the seagrass from the form, such as Cymodecea whose leaves are blunt and short in contrast to the fruit seagrass (Enhalus) though the ends of the leaves are dull but the leaves are long, as are the other types of seagrasses known to them by their morphology.

Fishermen recognize the seagrasses of its diversity. They recognize the place of life of each seagrass group, such as seagrass fruit in a muddy area but can be found together with Cymodocea and seagrass creeping (Halophila), grass (*Halodulle pinifolia* and *Syringodium isotifolium*) on the seashore. Moreover, fishermen recognize seagrass on the perspective of its benefits as a food source, where many marine biota live such as starfish, sea cucumbar, crebs, molluscs, see-urchin and economically important of fish. Their identification results are 3 species of Halophila, 2 species of Cymodocea and 1 species of each genus Halodulle, Thalassia Syringodium and Enhalus. Thus along with the distribution, the visible seagrass species Enhalus is found in the muddy area, Halophila in sandy areas and a bit of fine mud. Their identification results have been reported from the study area (Syukur, 2015). The knowledge of fishermen which is quite representative about the value of seagrass existence has scientific value to be an

indicator in seagrass conservation at study location. Nevertheless, there is always a difference in perception mainly due to whether the natural resources assessed have significant influence in their livelihood `(Daerden et al., 2007).

3.2. Perspective of Fisherman's on Seagrass Conservation at Study Area

Conservation is an attempt to create protection against the value of the existence of marine ecosystems such as seagrass ecosystems. Indonesia has been aware of the importance of seagrass conservation for marine sustainability and marine biodiversity, but is still limited to marine conservation area (DKP, 2008), On the other hand, it has not been received attention such as other ecosystems (coral reefs and mangroves) from among scientists and regulations (Nadiarti et al., 2012), so that the existence of seagrass outside the conservation area although it has been known the value of its existence from the ecological, economic and social aspects but there is no standard management (Syukur, 2016), although it has been reported the value of seagrass damage and the source of the threat of seagrass damage (Syukur et al., 2017). Therefore, an understanding of ecological systems in coastal areas and sources of sustainability threats is required. Small fisherman in recognizing the existence of seagrasses as described above, they understand the source of the threat of seagrass sustainability at the study area. The results of respondents assessment (Table 1) with parameters: construction of fishery dock, boat anchoring, over fishing and destructive fishing.

The results of the assessment of fishermen (Table 1), the fisherman's focus is the impact of over fishing and destructive fishing on seagrass conditions (changes in seagrass, covering and density) and the presence of economically valuable marine biota (molluscs, sea cucumbar, crebs and see-urchin). In this case, the impact of over fishing and destructive fishing can be seen from the results of the assessment of the fishermen as the respondent is 100% stating that the seagrass area has been lost a lot ± 20 ha. Due to abrasion as the impact of the development of fishery dock, 85% of respondents said the seagrass cover and density has decreased by utilization; and 76% of respondents stated that the scarcity of marine biota is economic value, effect due to over fishing and destructive fishing. In addition, in this study, the assessment of the level of

knowledge of small fishermen about the value of seagrass existence from (Table 2) and the accumulation of ecological knowledge of fishermen can illustrate their perspectives on seagrass conservation value.

Table1. The source of the threat and its value to the seagrass condition at the study area

	Score	Scale	Frequency	Functional Impact	Time of Recovery
	1	< 0,5 km^2	Never occurs	No impact	< 1 year
	2	0,5 km^2 – 1 km^2	Rare	Single species	1 -5 year
	3	1 km^2 – 5 km^2	Occasional	Single tropic level	5 - 10 year
	4	5 km^2 – 10 km^2	Annual or regular	Multiple tropic level	10 -20 year
	5	> 10 km^2	Persistent	Entire community	> 20Year
Threats	Scale		Frequency	Functional Impact	Recovery time
development of fishery dock	3		1	5	5
boat anchoring	2		4	1	1
over fishing	1		4	4	2
destructive fishing	2		4	4	3

The Small fishermen as respondents (Table 1) give different values on the same object. In this case, the personal aspect of each respondent has a significant influence. Nevertheless, there are many differences in the results of respondents' judgments that are inflated by 1) the intensity of interaction with the object; (2) degree of dependency; 3) education level and 4) benefits (Syukur, 2013). Fisherman's knowledge of seagrass species, distribution, covering and density, the biota associated with seagrass and the source of seagrass sustainability threat are indicators of their level of knowledge. In addition, the distribution of fisherman knowledge about the benefits of seagrass with the parameters of supporting services, provisioning services of material outputs and regulating and maintenance (Table 2) can be grouped into three levels that are less useful, useful and very useful. Furthermore, their level of understanding of the ecological aspects and threats of seagrass sustainability at the study area as a basis for assessing the

fisherman's perspective on seagrass conservation value at the study area. Their perspectives on conservation of seagrass from 100 respondents (Figure 2).

Table 2. Distribution of respondents based on the assessment of seagrass benefits to fish and seagrass marine biota n= 100

No	Parameter	Distribution of the number of respondents on each scoring score				
		No benefits	Less benefits	Enough benefits	benefits	benefits
		1	2	3	4	5
A.	**Supporting services**					
1	Habitat of fish	0	12	40	30	18
2	Habitat of small fish	0	3	45	31	13
3	Feeding grounds	0	0	42	44	14
4	The place of the fish sheltered from the sun and predators	0	0	65	20	15
5	Habitat of marine life other than fish	0	0	56	34	10
6	Habitat of marine life other than fish	0	0	68	20	12
7	Water fertility resources	0	0	36	43	11
B	**Supporting services outputs**					
1	Food	0	0	72	19	9
C	**Regulating dan maintenance**					
1	Mud traps	0	0	54	41	5
2	Increase the clarity of seawater	0	0	44	52	4
3	Coastal protection from abrasion	0	10	37	40	13
4	The regulates gas through CO_2 uptake and releases O_2	0	5	64	23	8

Results of in-depth discussions and interviews with respondents, where all small fishermen as respondents stated over-exploitation and destructive fishing (e, g, bomb and potassium) as the main source of threat. Furthermore, stated two factors have caused scarcity of fish and marine biota. The population of several biota (e.g., sea cucumbers, sea-urchin, sea cucumber mollusca, crabs, and sea horses that have become rare commodities in marine waters at study sites (Satyawan *et al*., 2014). Furthermore, some types of targets such as lemuru fish, fish cucut, squid and glutinous fish have exceeded the potential of sustainability (Karnan *et al.,*2012; Santoso *et al*., 2015). However, this condition has been an

inspiration for fishermen in marine protection. In this case, where more than 88% of respondents stated seagrass conservation is urgently needed to prevent the sustainability of destructive and over-exploitative.

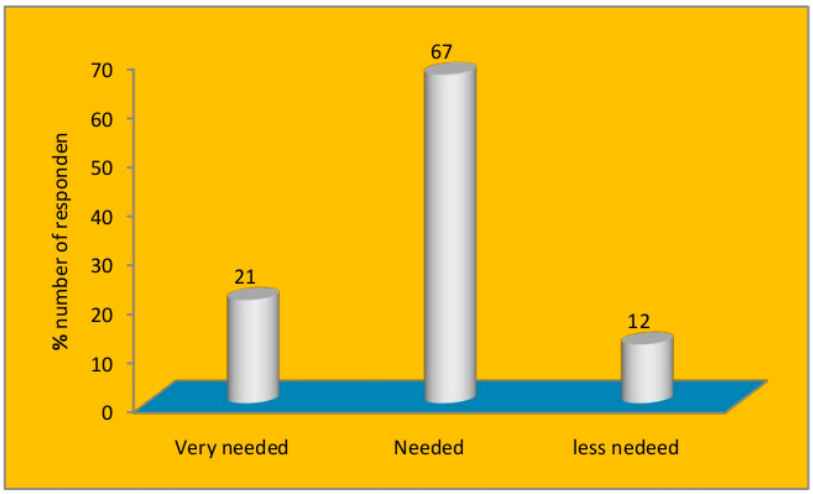

Figure 2. The need of seagrass conservation from the perspective of fishermen

3.3. The Friendly Environmental Cultivation in the Study Area

Seagrass conservation as an instrument of increasing income of small-scale fishermen can be effective when a group of small-scale fishermen gets benefit from conservation efforts. One form of fishing activities which mutual support with seagrass conservation efforts in the study area is a friendly environmental cultivating. In this respect, environmental friendly aquaculture that has economic value significantly as complement of small fishery and can develop into a major source of sustainable livelihood (Perez *et al*., 2012) and recognition of the value of seagrass meadows as ecosystem service providers is growing but thes ecosystems appear to have an image problem.

Small fishermen at the study sites develop cultivation as complementary to their prefession as fishermen. The cultivation developed is the cultivation system on the floating cage. The development of cultivation in the study area from the observation before 2015 is still done by certain people, but starting in 2015 the development of cultivation has been done by fishermen in the study area. Results of discussions and in-depth interviews with fisherman fishermen stated that the

current cultivation is the source of their livelihood and their perspectives for cultivation are 1) sufficient time, (2) cultivation security because it is done in groups, new employment sources for fishing and community families, and 3) cultivation is a means of saving.

The small scale fisheries cultivation indicators of small-scale fishermen from interviews and in-depth discussions with cultivators are grouped into two; 1) cultivation inputs (seeds and feed) and 2) utilization of the marine environment in non-destructive ways (bombs, potassium and damaging tools. The relates to the potential of seed and the potential of feed that comes from the surrounding environment (Syukur et al., 2016). The types of cultivation developed by fishermen in the study sites are fish and lobster. Furthermore, Siganidae fish (rabbifish) from a fisherman's perspective is the most abundant type of fish, especially in February-April. In addition rabbit fish species are fish species that are easy to catch. Rabbit fish is a herbivorous fish so the feed for cultivation not only from fish but can be derived from marine plants such as algae. In addition, the cultivation sustainability of the interviews and in-depth discussions were obtained by the cultivation management system which includes several aspects 1) the management of seeds and feed as input production; 2) security, the security management was carried out together with the adjacent floating net cage placement system and 3) marketing managed directly by the group.

The value comprehensively describes the ability of conservation area fully for the conservation of biodiversity, the adequacy illustrates a potency of conservation area from the whole geographical area for the sustainability of the species and ecological communities, and representative acreage demonstrates the ability to ensure adequate conservation of a number of individuals and species which can survive in the long term. Furthermore, to achieve the goal of environmental friendly farming can be an instrument of economic development with a group of small-scale fishermen by using a cooperative approach. This approach was chosen because of small-scale fishermen has a cooperation habit in groups as a single working unit for fishermen in catching fishes (Basurto *et al.*, 2013). An other thing that is very important is the result of a cooperative approach

can accommodate differences among members as a force in achieving a common goal.

Cooperative approach has advantages as a community empowerment approach because it has properties as follows 1) participative; 2) coordinative; 3) collaborative and 4) consultative (Wright *et al.*, 2006). The results of cooperative approach obtained indicators of sustainable cultivation environmentally friendly sourced from small-scale fishermen in the study area are 1) fish seeds of environmentally friendly aquaculture can be found from the surrounding environment; 2) fish seeds always available for propagation; 3) fish foods can be obtained from the environment, especially for Siganidae ; 4) marketable and has a high economic value and 5) a new income source for small-scale families's fishermen

IV. Conclusion

Seagrass conservation can be an instrument in empowering coastal communities, especially small fishermen. The knowledge of small fishermen about the seagrass ecology value is significant to describe their perspective about the value of seagrass conservation. The value of seagrass conservation has a significant contribution to the sustainability of eco-friendly cultivation on a small scale fisherman as in the study area. Therefore, it should be considered in the policy at local, regional and national level of seagrass conservation based on empowering small fishermen through a friendly environmental cultivation.

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